14472 Hz

Patent claims

1. Method for detecting the modes of a dynamic system with a large number of modes s_i that each have a set α (t) of characteristic system parameters, in which a time series of at least one system variable x(t) is subjected to modeling so that in each time segment of a predetermined minimum length a predetermined prediction model f_i for a system mode s_i is detected for each system variable x(t), characterized in that the modeling of the time series is followed by drift segmentation in which, in each time segment in which there is transition of the system from a first system mode s_i to a second system mode s_j, a series of mixed prediction models g_i is detected produced by linear, paired superimposition of the prediction models $f_{i,j}$ of the two system modes $s_{i,j}$.

2. Method according to claim 1 in which the modeling is a switch segmentation.

3. Method according to claim 2 in which the switch segmentation takes the form of simulation of a training time series of the system or of the time series to be investigated with several, competing prediction models.

4. Method according to claim 3 in which the prediction models are formed by neural networks or other models for estimating functions that are each characteristic of a mode s and compete for description of the individual elements of the time series according to predetermined training rules.

5. Method according to one of the claims 1 through 4 in which the series of mixed system modes g_i is determined from the prediction models $f_{i,j}$ and interpolation parameters a, b according to $g_i = a(s) f_{i(s)}(x) + b(s) f_{j(s)}(x)$.

6. Method according to claim 5 in which the interpolation parameters are selected according to $0 < a(s) < 1$ and $b(s) = 1 - a(s)$.

7. Method according to claim 6 in which the values a(s) are restricted to a certain resolution figure R and/or are equidistant.

8. Method according to one of the preceding claims in which the series of mixed prediction models g_i is detected by determining a prediction for each time increment with each of the possible prediction models, resulting in a time-dependent prediction matrix from which a mean prediction error for randomly selected segmentations can be derived, whereby the sought series of mixed prediction models g_i is the segmentation with the smallest prediction error or the maximum probability.

9. Method according to claim 8 in which the search for the segmentation with the smallest prediction error is made by a dynamic programming technique that is equivalent to the Viterbi algorithm for hidden Markov models, whereby an optimum sequence of prediction models is determined using a minimized cost function C* of the prediction and the segmentation is derived inductively from the sequence of prediction models.

10. Method according to one of the preceding claims in which drift segmentation is followed by an additional step to reduce the number of prediction models used for modeling where the number of prediction models is reduced sequentially, associated with a determination of the mean prediction error,

until a further reduction of the number of prediction models means an increase in the prediction error.

11. Method according to one of the preceding claims in which the time series of at least one of the system variables $x(t)$ comprises a time series of physiological parameters described by the Mackey-Glass delay differential equation $dx(t) / dt = -0.1x(t) + 0.2x(t - t_d)/1 + x(t - t_d)^{10}$.

12. Method according to one of the claims 1 through 11 in which the time series of at least one of the system variables $x(t)$ comprises a time series of physiological parameters that are characteristic of the development of sleep and wake modes.

13. Method according to claim 12 in which the physiological parameters comprise EEG signals.

14. Method according to one of the claims 1 through 10 in which the time series of at least one of the system variables $x(t)$ comprises a time series of speech signals.